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LISTING OF CLAIMS

1. (cancelled)
2. (cancelled)
3. (cancelled)
4. (cancelled)
5. (cancelled)
6. (cancelled)
7. (cancelled)
8. (cancelled)
9. (cancelled)
10. (currently amended) A copper electroplating bath, comprising:
water as a solvent;
copper ions;
pyrophosphate anions;
cations other than copper ions added to the electroplating bath as a salt of said anions,
such that said anions are present in the electroplating bath in stoichiometric excess relative to
said copper ions; and

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2,5-dimercapto-1,3,4-thiadiazole at a concentration of less than 4 μM ,
whereby copper metal is electrodeposited in Damascene trenches and vias to form circuitry
on semiconductor chips
~~an organic additive compound that tends to accelerate the copper electrodeposition~~
~~rate.~~

11. (original) The copper electroplating bath of Claim 10, wherein said cations other than copper ions are not electroactive at the potential used for copper electrodeposition, such that relatively pure copper metal is deposited.

12. (original) The copper electroplating bath of Claim 11, wherein said cations other than copper ions are selected from the group consisting of K^+ , Na^+ , and NH_4^+ ions.

13. (original) The copper electroplating bath of Claim 10, further comprising:
a surfactant.

14. (original) The copper electroplating bath of Claim 13, wherein said surfactant is polyoxyethylene(10)isooctylphenylether.

15. (original) The copper electroplating bath of Claim 10, further comprising:
ions of at least one electroactive metal selected from the group consisting of silver, zinc, cadmium, iron, cobalt, nickel, tin, lead, bismuth, antimony, gallium and indium, such that a copper alloy deposit is obtained.

16. (cancelled)

17. (original) The copper electroplating bath of claim 10, wherein the temperature is

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maintained between 50°C and 60°C.

18. (original) The copper electroplating bath of Claim 10, wherein the pH is maintained in the 8.0 to 8.8 range.

19. (original) The copper electroplating bath of Claim 10, further comprising:
ammonia or ammonium ion.

20. (original) The copper electroplating bath of Claim 10, further comprising:
nitrate ion.

21. (cancelled)

22. (cancelled)

23. (cancelled)

24. (currently amended) A copper electroplating bath, comprising:
water as a solvent;
copper ions;
pyrophosphate anions;
cations other than copper ions added to the electroplating bath as a salt of said anions,
such that said anions are present in the electroplating bath in stoichiometric excess relative to
said copper ions;

2,5-dimercapto-1,3,4-thiadiazole at a concentration of less than 4 ~~in the range from 1~~
~~to 5~~ μM ; and
a surfactant,

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whereby copper metal is electrodeposited in Damascene trenches and vias to form circuitry on semiconductor chips.

25. (currently amended) A copper electroplating bath, comprising:

water as a solvent;

copper ions;

pyrophosphate anions;

cations other than copper ions added to the electroplating bath as a salt of said anions, such that said anions are present in the electroplating bath in stoichiometric excess relative to said copper ions;

2,5-dimercapto-1,3,4-thiadiazole at a concentration of less than 4 ~~in the range from 1 to 5~~ μM ,

polyoxyethylene(10)isooctylphenylether as a surfactant;

ammonia or ammonium ion; and

nitrate ion,

whereby copper metal is electrodeposited in Damascene trenches and vias to form circuitry on semiconductor chips.

26. (currently amended) A process for electrodepositing copper circuitry in trenches and vias on semiconductor chips, comprising the steps of:

providing a semiconductor chip with trenches and vias to be filled with copper;

placing said chip in contact with an electroplating bath, said bath comprising:

water as a solvent,

copper ions,

pyrophosphate anions,

cations other than copper ions added to the electroplating bath as a salt of said anions, such that said anions are present in the electroplating bath in stoichiometric

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excess relative to said copper ions, and

2,5-dimercapto-1,3,4-thiadiazole at a concentration of less than 4 ~~in the range from 1 to 5~~ μM , and

electrodepositing copper in said trenches and vias.

27. (original) The process of Claim 26, wherein said cations other than copper ions are selected from the group consisting of K^+ , Na^+ , and NH_4^+ ions.

28. (original) The process of Claim 26, wherein the electroplating bath further comprises a surfactant.

29. (original) The process of Claim 28, wherein said surfactant is polyoxyethylene(10)isooctylphenylether.

30. (original) The process of Claim 26, wherein the temperature of the plating bath is maintained at a temperature between 50°C and 60°C .

31. (original) The process of Claim 26, wherein the pH of the electroplating bath is maintained in the 8.0 to 8.8 range.

32. (original) The process of Claim 26, wherein the electroplating bath further comprises ammonia or ammonium ion.

33. (original) The process of Claim 26, wherein the electroplating bath further comprises nitrate ion.

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CONCLUSIONS

The arguments presented here show that present inventors were the first to recognize that a copper pyrophosphate plating bath having a low concentration of the DMTD additive, which accelerates the copper electrodeposition rate, could provide bottom-up filling of Damascene trenches and vias.

In consideration of the arguments presented and the claim amendments made, it is respectfully requested that all of the remaining claims, as amended, be allowed.

Respectfully submitted,



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